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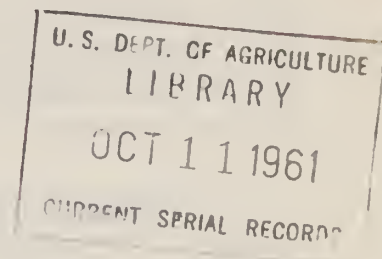
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The Uses of Body Measurements in Estimating Body  
Weight and in Evaluating Growth in Cattle 1/

Prepared by Specialists in the  
Animal Husbandry Research Division



One of the earliest uses of body measurements appears to have been in the estimation of weight. Studies of this nature were begun in Europe prior to 1800. A review published in 1893 shows that a number of such studies were made during the 19th Century. During that period the measurements most commonly used were heart girth, body length and a formula based on body length and paunch girth. It seems likely that these early studies of heart girth may have provided the basis for tapes and girthing chains as there is evidence that both were used in Europe during the 19th Century, and it is known that the girthing chain was in common use in New England at least 100 to 150 years ago.

More recently there has been a notable increase in efforts to establish more precise methods of estimating weight from body measurements. Since 1900 nearly 40 reports have appeared. They were published in 14 countries in addition to the United States, and included approximately 40 different breeds of cattle and a number of crossbreds. Studies were made of dairy, beef, dual purpose and "Fat" cattle. Both sexes, and ages from early calthood to maturity were represented. The interest in the subject has been particularly noteworthy since 1950. About half of the investigators gave results either in tables or graphs to show measurement-weight equivalents. More than a third expressed results as correlations or regressions. A similar number used various formulas, and some confined their efforts mainly to comparisons of the techniques and procedures used by others. Two excellent reviews have appeared within the past 5 years (1) (3).

Most of the investigators employed measurements in common usage such as body lengths, widths or circumferences. A few compared correlations of 13 to 14 different measurements with weight. Some unique measurements were used. "The Round", proposed by Gregory (2) consisted of a tapeline measurement, in a horizontal plane, around the rear from patella to patella. Correlations between this measurement and weight were reported as .42 and .88; in studies by different investigators. The "Crevat Formula", described by Regensburger (4) employed a measurement taken with a tapeline from a point

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1/ Paper presented by W. W. Swett at Symposium on Body Measurements, NC-2 Technical Committee, held November 1959 at East Lansing, Michigan.



on the midline between the thighs, around and over the back midway between withers and hips, down the opposite side to the brisket and returning by a similar route on the opposite side of the animal to the starting point. Apparently it was designed in an attempt to include circumference and length in a single measurement. This formula was reported as giving slightly better accuracy than heart girth with weight but its use was not recommended because of high variability in the measurement.

Heart girth was the measurement most extensively used. It was included in 33 of 39 reports reviewed. It was most frequently used alone, primarily in developing tables, graphs and girthing tapes, but it provided the basis for numerous formulas. It was also extensively used in correlation studies. The correlations reported varied with breeds and types but nearly all were positive, highly significant and of high magnitude. Of the 20 correlations noted 17 ranged between .73 and .98 (average .89). One correlation obtained with Fat Stock show cattle was .48. In Beltsville Holsteins heart girth most consistently showed the highest correlation among 8 measurements compared, at ages from 3 months to maturity. The range for seven ages was .85 to .88. Correlations for formulas based on heart girth alone or in combination with other measurements were as varied as the formulas themselves and claims for their accuracy could not easily be evaluated. One reviewer (1) found that heart girth was the best single measurement but that including length and paunch girth increased the accuracy of estimation. In another review (3) it was concluded that weight can be estimated as well or better by heart girth as by combinations of measurements.

Height at withers was less extensively used. It appeared in a number of tables and graphs and in some correlation studies. Correlations with weight ranged from .38 to .73 in studies with different breeds and ages. Body length was seldom used alone. Correlations with weight ranged from .44 to .96 in different studies. One of its principal uses was in formulas for estimating body volume.

The consensus of opinion expressed seems to be that although some combinations of measurements gave results equal in accuracy to those based on heart girth, heart girth alone was to be recommended because of the simplicity of its application.

A number of measurements have been used to establish averages or "standards" of body dimensions at successive ages to provide bases for comparing growth and size in various breeds and type of cattle. Growth, however, is more than increase in size. In early Missouri studies initiated by Waters about 1904 it was shown that body proportions develop differently in animals on varying levels of nutrition, that the rate of growth is not necessarily regular, and that recovery after periods of adversity usually is brought about either by an increase in growth rate or by an extension of the growth period.

There is evidence also that, under continuous good nutrition and management, dairy cattle do not grow symmetrically. Studies of Beltsville data have been made to show how various dimensions at successive ages compare with the same dimensions at maturity. At 3 months of age the average percentages of maturity for Holsteins were: heights, 65, head length 56, body lengths 52, body depths and body circumferences 50, and body widths 45. At first lactation these percentages were within the range of 92 to 98. Percentages for Jerseys were similar.

Head length is sometimes considered a basic measurement for studies of body proportions. In Beltsville Holsteins the ratio of height at withers to head length decreased from 2.81 at 3 months to 2.51 at maturity (-11%). By contrast width of paunch increased from 1.03 to 1.29 (+25%), width of hips .75 to 1.04 (+39%), and width of pinbones .53 to .71 (+34%).

Studies of Beltsville Holsteins show also that other body proportions change with age. Legginess, the percentage of total height at withers located below the chest floor, decreased rather steadily from 56.5 at 3 months of age to 45.2 at maturity. Slope of rump increased from 3.4 to 7.4 degrees, while the ratio of length to width of head increased from 2.4 to 2.9 during the same period of time. Wedge shape (depth), the ratio of paunch depth to chest depth, ranged between 1.00 and 1.06 at the various ages. It declined slightly with age. Wedge shape (depth) as viewed from the side may be deceptive. The average excess of paunch depth over chest depth in Holsteins at maturity was only 1.1 inches. The greatest individual excess recorded among mature Holsteins was 3.6 inches. Depth of udder is believed to have a strong influence on the visual evaluation of the depth wedge in cows.

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- (1) Burt, A. W. A. The Comparative Efficiency of Some Methods of Estimating 1957 the Live Weight of Dairy Cows. (A Review) Jour. Dairy Research 24:2, 144-151.
  - (2) Gregory, P. W. The Mature Size Factors in Domestic Breeds of Cattle. 1933 Genetics 18:221-249.
  - (3) Johansson, Ivar, and Hildeman, Sven Eric. The Relationship Between 1954 Certain Body Measurements and Live and Slaughter Weight in Cattle. (A Review) Animal Breeding Abstracts 22:1, 1-17.
  - (4) Regensburger, Gianfranco. Contributo Alla Valutazione Del Peso Vivo 1955 Dei Bovini in Relazione ad Alcune Dimensioni Somatiche. Nota 2. Ann. della Sperimentazione Agraria. Rome N.S. 9:3, 571-603.



